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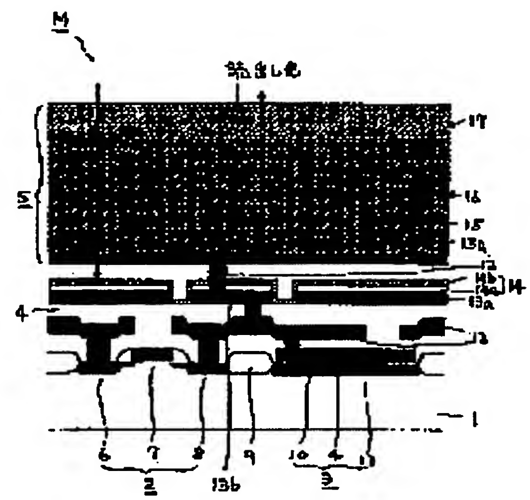
(54) REFLECTION TYPE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To obtain a reflection type liquid crystal display device which can yield excellent contrast by decreasing the reflectance of an anti reflection film below 10% over the entire visible light region.
SOLUTION: On a substrate 1, at least transistors 2, an insulating layer 4, a shading film 13a formed of metal formed so as to cover the transistors 2 in the insulating layer 4, the reflection preventive film 14, pixel electrodes 15 arrayed having a prescribed pixel pitch, a liquid crystal layer 16, and a glass substrate 17 covering the entire surface of the liquid crystal layer 16 are stacked in order and a wiring layer 12 is provided to connect the transistors 2 and pixel electrodes 15, thus constituting the reflection type liquid crystal device. In this case, the reflection preventive film 14 is composed of nitride 14a and a dielectric film 14 with a different refractive index from the insulating layer 4 which are formed in order on the shading film 13a.



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CLAIMS

[Claim(s)]
[Claim 1] The light-shielding film which consists of a metal formed into the transistor, the insulating layer, and said insulating layer on the substrate as covered said transistor at least, The antireflection film, the pixel electrode arranged by having a predetermined pixel pitch, and a liquid crystal layer, In the reflective mold liquid crystal display which consists of a wiring layer which the laminating of the whole surface wrap glass substrate is carried out one by one in said liquid crystal layer, and connects said transistor and said pixel electrode said antireflection film The reflective mold liquid crystal display characterized by consisting of a nitride by which sequential formation was carried out on said light-shielding film, and a dielectric film with which said insulating layer and refractive index differ from each other.
[Claim 2] Said antireflection film is a reflective mold liquid crystal display according to claim 1 characterized by being the film which has 10% or less of reflection factor to the wavelength of 4000A thru/or 7000A light.
[Claim 3] It is the reflective mold liquid crystal display according to claim 1 or 2 which said nitride is titanium nitride and is characterized by said dielectric film being silicon nitride.
[Claim 4] Said light-shielding film is a reflective mold liquid crystal display according to claim 1 to 4 which is aluminum and is characterized by making thickness of 800A thru/or 1200A, and said silicon nitride into 500A for the thickness of said titanium nitride.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention carries out incidence of the read-out light, and relates to the reflective mold liquid crystal display which displays by reflecting this read-out light.
[0002]
[Description of the Prior Art] Before, the liquid crystal projector using the liquid crystal display of a transparency mold or a reflective mold is known. Since the drive circuit and wiring which drive liquid crystal are in the field of a liquid crystal panel and are formed around the pixel by width of face of about about 10 micrometers, the liquid crystal display of a transparency mold has the low rate (henceforth a numerical aperture) that the pixel field concerning the light modulation to the whole viewing-area surface of a liquid crystal panel occupies. Also in ******, a numerical aperture has only about 60% of report also at the high transparency mold liquid crystal display of a numerical aperture. a transparency mold liquid crystal display — the increase (high resolution) of the number of pixels — a pixel — a consistency — the liquid crystal projector which carried this transparency mold liquid crystal display since the numerical aperture fell when it went up — high — it was difficult to obtain a brightness display image. Then, it has put in practical use in recent years by developing the liquid crystal projector using the reflective mold liquid crystal display as a liquid crystal projector of high brightness and high resolution.
[0003] A reflective mold liquid crystal display is formed between two or more pixel electrodes which have a predetermined pitch and were formed in the shape of a matrix on the profile and the substrate, and said substrate and said pixel electrode, and has the configuration which consists of a drive circuit which drives said pixel electrode, and a liquid crystal layer formed on said pixel electrode. Actuation of this reflective mold liquid crystal display irradiates read-out light from said liquid crystal layer side, and is performed by emitting the information light by which light modulation was carried out corresponding to said image information while writing image information in said liquid crystal layer by said drive circuit.
[0004] Usually, in the case of the reflective mold liquid crystal display which has the pixel electrode pitch of 14 micrometers, for example, since the fields without regards to the light modulation of this reflective mold liquid crystal display which become invalid are said pixel inter-electrode 0.5 thru/or about 0.7 micrometers, they can obtain 90 thru/or 93% of numerical aperture. Therefore, the reflective mold liquid crystal display attracts attention as a suitable liquid crystal display to offer the liquid crystal projector of high brightness and high resolution.

[0005] Such a reflective mold liquid crystal display is explained using drawing 5 R> 5 and drawing 6 . Drawing 5 is the sectional view showing the liquid crystal panel of the conventional reflective mold liquid crystal display. Drawing 6 is the top view showing signs that the conventional reflective mold liquid crystal display was seen from the top face. As shown in drawing 5 and drawing 6 , on a silicon substrate 1, MOS transistors 2 and retention volume 3 which were formed by standing in a row on this silicon substrate 1, and such MOS transistors 2 and retention volume 3, the pixel A which consists of an interlayer insulation film 4 which consists of a refractive index 1.45 by which sequential formation was carried out, and a liquid crystal cell 5 arranges the liquid crystal panel of the conventional reflective mold liquid crystal display, and it is constituted. The separation oxide film 9 was formed between MOS transistor 2 and retention volume 3, and MOS transistor 2 and retention volume 3 are electrically divided into it. MOS transistor 2 consists of the gate 7 pinched between the source 6, the drain 8, and the source 6 and a drain 8.

[0006] Retention volume 3 consists of a high concentration layer 10 formed into the silicon substrate 1, and a maintenance electrode 11 by which opposite arrangement was carried out through the interlayer insulation film 4 at this high concentration layer 10. It comes to carry out the laminating of the glass substrate 17 to the pixel electrode 15 which a liquid crystal cell 5 has pixel inter-electrode spare time 15a, and consists of aluminum, and the liquid crystal layer 16 one by one. Light-shielding film 13a which consists of aluminum with a predetermined pitch is formed between MOS transistor 2, pixel inter-electrode spare time 15a, and the pixel electrode 15 so that it may mention later, and the read-out light which invades from pixel inter-electrode spare time 15a into an interlayer insulation film 4 may not invade into MOS transistor 2.

[0007] Wiring layer 13b is connected to the drain 8 and the maintenance electrode 11 of the pixel electrode 15 and MOS transistor 2 through the wiring layer 12. Furthermore, on light-shielding film 13a and wiring layer 13b, the antireflection film 14 which consists of titanium nitride is formed. Moreover, the source 6 of MOS transistor 2 is connected to picture signal wiring which is not illustrated at the scan signal wiring which does not illustrate the gate 7.

[0008] Next, actuation of the liquid crystal panel of the conventional reflective mold liquid crystal display is explained. Through picture signal wiring which is not illustrated, where a picture signal is impressed to the source 6, if a scan signal joins the gate 7, MOS transistor 2 will serve as ON, the charge of a picture signal will be charged by retention volume 3 and the liquid crystal cell 5, and this picture signal will be written in the liquid crystal layer 16 through the scan signal wiring which is not illustrated. In this condition, if incidence of the read-out light is carried out to a liquid crystal cell 3 from a glass substrate 17 side, according to a picture signal, while passing a liquid crystal cell 3, light modulation is received in the liquid crystal layer 16, it is reflected by an antireflection film 14 and the pixel electrode 15, and again, by the liquid crystal layer 16, light modulation of this read-out light will be carried out, and it will be injected as an image information light from a glass substrate 17. Image display can be performed by carrying out expansion projection of the image information light emitted from this glass substrate 17 on a screen.

[0009]

[Problem(s) to be Solved by the Invention] However, the conventional reflective mold liquid crystal display had the following troubles. In the case of the veneer method using said liquid crystal panel, one light of all light fields (wavelength of 4000A thru/or 7000A) is used, but a reflection factor only becomes low only to the light of the wavelength of the one section in this, and the titanium nitride used for the oxide film used for an interlayer insulation film 4 and the antireflection film 14 cannot carry out acid resisting to the light of the other wavelength. For this reason, interference was produced between the read-out light which it invades into the liquid crystal layer 17 of the pixel in which it is reflected with an antireflection film 14, and which the read-out light which carries out incidence adjoins from pixel inter-electrode spare time 15a, and is irradiated by the pixel which adjoined, and the fall of contrast was produced. For this reason, the quality display image which has good contrast was not obtained. Since it can prevent invading into the liquid crystal layer 16 of the pixel in which it is reflected with an antireflection film 14 and which read-out light adjoins if the reflection factor of an antireflection film 14 is 10% or less to all light fields and it is generally said that contrast is not degraded sharply, to make the reflection factor of an antireflection film 14 10% or less is needed. Moreover, what is necessary is just to carry out acid resisting of the three antireflection films 14 used for red, blue, and a green liquid crystal panel, respectively to each to the light which carries out incidence in the case of 3 plate methods using a liquid crystal panel. That is, in the antireflection film 14 of the liquid crystal panel used for red, if acid resisting only of the red (light whose wavelength is 6000A thru/or 7000A) is carried out, since the good image of contrast can be obtained, in all light fields, it is not necessary to stop this reflection factor to 10% or less. However, in each, red, blue, and a green liquid crystal panel were able to change thickness of an antireflection film 14, needed to attain optimization, and were not able to perform communalization of red, blue, and a green liquid crystal panel. For this reason, productivity was reduced. Moreover, when the acid-resisting effectiveness of the antireflection film 14 on light-shielding film 13a was low, the read-out light which carries out incidence from pixel inter-electrode spare time 15a spread between an antireflection film 14 and the pixel electrodes 15, reached MOS transistor 2, and was degrading the transistor engine performance of this MOS transistor 2.

[0010] Then, this invention is made in view of the above-mentioned problem, and it goes across it throughout a light field, it makes the reflection factor of an antireflection film 10% or less, and aims at offering the reflective mold liquid crystal display with which good contrast is acquired.

[0011]

[Means for Solving the Problem] At least the reflective mold liquid crystal display of this invention on a substrate A transistor, An insulating layer and the light-shielding film which consists of a metal formed into said insulating layer as covered said transistor, The antireflection film, the pixel electrode arranged by having a predetermined pixel pitch, and a liquid crystal layer, In the reflective mold liquid crystal display which consists of a wiring layer which the laminating of the whole surface wrap glass substrate is carried out one by one in said liquid crystal layer, and connects said transistor and said pixel electrode said antireflection film It is characterized by consisting of a nitride by which sequential formation was carried out on said light-shielding film, and a dielectric film with which said insulating layer and refractive index differ from each other.

[0012] 2nd invention is characterized by said antireflection film being film which has 10% or less of reflection factor to the

wavelength of 4000A thru/or 7000A light in a reflective mold liquid crystal display according to claim 1.
[0013] In a reflective mold liquid crystal display according to claim 1 or 2, said nitride of the 3rd invention is titanium nitride, and said dielectric film is characterized by being silicon nitride.
[0014] The 4th invention is [0015] which said light-shielding film is aluminum in a reflective mold liquid crystal display according to claim 1 to 4, and is characterized by making thickness of 800A thru/or 1200A, and said silicon nitride into 500A for the thickness of said titanium nitride.
[Embodiment of the Invention] Hereafter, the reflective mold liquid crystal display of this invention is explained with reference to drawing 1 thru/or 4. The reflective mold liquid crystal display of this invention makes the antireflection film 14 the pixel M it was made to consist of two-layer [of titanium nitride (henceforth TiN) 14a, and silicon nitride (henceforth SiN) 14b] instead of the pixel A of the conventional reflective mold liquid crystal display. Drawing 1 is drawing showing 1 pixel of the liquid crystal panel of the reflective mold liquid crystal display of this invention. Drawing 2 is drawing showing the relation between the reflection factor at the time of making the thickness of the silicon nitride by which sequential formation was carried out, and titanium nitride fix on aluminum, and wavelength. Drawing 3 is drawing showing the relation between the reflection factor at the time of fixing the thickness of titanium nitride on aluminum among the silicon nitride and titanium nitrides by which sequential formation was carried out, and changing the thickness of silicon nitride, and wavelength. Drawing 4 is drawing showing the relation between the reflection factor at the time of fixing the thickness of silicon nitride on aluminum among the silicon nitride and titanium nitrides by which sequential formation was carried out, and changing the thickness of titanium nitride, and wavelength. The same sign is given to the same configuration as the former, and the explanation is omitted.
[0016] As shown in drawing 1 , on a silicon substrate 1, MOS transistors 2 and retention volume 3 which were formed by standing in a row on this silicon substrate 1, and such MOS transistors 2 and retention volume 3, the liquid crystal panel of the reflective mold liquid crystal display of this invention arranges the pixel M which consists of an interlayer insulation film 4 by which sequential formation was carried out, and a liquid crystal cell 5, and is constituted. The separation oxide film 9 was formed between MOS transistor 2 and retention volume 3, and MOS transistor 2 and retention volume 3 are electrically divided into it. MOS transistor 2 consists of the gate 7 pinched between the source 6, the drain 8, and the source 6 and a drain 8.
[0017] Retention volume 3 consists of a high concentration layer 10 formed into the silicon substrate 1, and a maintenance electrode 11 by which opposite arrangement was carried out through this high concentration layer 10 and interlayer insulation film 4. Light-shielding film 13a which consists of aluminum with a predetermined pitch is formed between MOS transistor 2, pixel inter-electrode spare time 15a, and the pixel electrode 15 so that it may mention later, and the read-out light which invades from pixel inter-electrode spare time 15a into an interlayer insulation film 4 may not invade into MOS transistor 2. A liquid crystal cell 5 consists of the pixel electrode 15 which consists of aluminum with pixel inter-electrode spare time 15a, a liquid crystal layer 16 by which sequential formation was carried out on this pixel electrode 15, and a glass substrate 17.
[0018] Furthermore, wiring layer 13b is connected to the drain 8 and the maintenance electrode 11 of the pixel electrode 15 and MOS transistor 2 through the wiring layer 12. The antireflection film 14 is formed on light-shielding film 13a and wiring layer 13b. This antireflection film 14 carries out the laminating of the SiN14b on TiN14a. Under the present circumstances, the thickness of TiN14a is 800A thru/or 1200A, and the thickness of SiN14b is 500 on-SUTOROMU. Since SiN14b is an insulator, while being formed on TiN14a, it is formed also into an interlayer insulation film 4, and it is formed so that the read-out light which invades from pixel inter-electrode spare time 15a may spread between the pixel electrode 15 and TiN14a and may not reach MOS transistor 2. The refractive index of this SiN14b is 2.00, and differ in an interlayer insulation film 4. The source 6 of MOS transistor 2 is connected to picture signal wiring which is not illustrated at the scan signal wiring which does not illustrate the gate 7.
[0019] Next, actuation of the reflective mold liquid crystal display of this invention is explained. Through picture signal wiring which is not illustrated, where a picture signal is impressed to the source 6, if a scan signal joins the gate 7, MOS transistor 2 will serve as ON, the charge of a picture signal will be charged by retention volume 3 and the liquid crystal cell 5, and this picture signal will be written in the liquid crystal layer 16 through the scan signal wiring which is not illustrated. In this condition, if incidence of the read-out light is carried out to a liquid crystal cell 3 from a glass substrate 17 side, according to a picture signal, while passing a liquid crystal cell 3, light modulation is received in the liquid crystal layer 16, it is reflected by an antireflection film 14 and the pixel electrode 15, and again, by the liquid crystal layer 16, light modulation of this read-out light will be carried out, and it will be injected as an image information light from a glass substrate 17. Image display can be performed by carrying out expansion projection of the image information light emitted from this glass substrate 17 on a screen.
[0020] Here, the light was irradiated at the pixel M of the reflective mold liquid crystal display of this invention, and TiN14a and SiN14b were investigated on aluminum about the relation of the reflection factor of the antireflection film 14 of structure and the wavelength of a light field which carried out sequential formation. The result is explained using drawing 2 thru/or drawing 4 . Using the wavelength of 4000A thru/or the 7000A light as a read-out light, the reflection factor of an antireflection film 14 carries out incidence of this read-out light from a glass substrate 17 side, and is called for by measuring the rate to the read-out light of the reflected light of this read-out light. Here, a display shows a reflection factor 100%. In measurement of the reflection factor of this antireflection film 14, the thickness of TiN14a and SiN14b was changed and was investigated. TiN with a thickness of 800A and SiN with a thickness of 500A are first explained using drawing 2 about the relation between the reflection factor at the time of carrying out sequential formation, and the wavelength of a light field on aluminum.
[0021] In drawing 2 , the reflection factor of TiN and aluminum formed on aluminum for the comparison is shown. * TiN by which sequential formation was carried out on aluminum (800A in thickness), It is SiN (500A in thickness) (henceforth SiN (500A)/TiN (800A) / aluminum), ** is TiN (800A in thickness) (henceforth TiN (800A)/aluminum) formed on aluminum, and ** is aluminum. The reflection factor of SiN(500A)/TiN (800A) / aluminum is crossed to the wavelength of 4000A thru/or a

7000A field to the reflection factor of TiN (800A) / aluminum and aluminum being 10% or more, and it is 10% or less. If it is made from this the structure which carried out sequential formation of TiN with a thickness of 800A and the SiN with a thickness of 500A on aluminum, it turns out that 10% or less of reflection factor is obtained in the wavelength of 4000A thru/or a 7000A field.

[0022] Next, SiN to which thickness changed thickness with 800A TiN is explained using drawing 3 about the relation between the reflection factor at the time of carrying out sequential formation, and the wavelength of a light field on aluminum. In drawing 3 , the thickness of * of SiN is 200A (henceforth SiN200), the thickness of ** of SiN is 500A (henceforth SiN500), and the thickness of ** of SiN is 800A (henceforth SiN800). Although SiN200 is 10% or less of reflection factor in the wavelength of 4000A thru/or the range of 6500A, in 6500A thru/or 7000A, 10% or more is shown and SiN800 shows 10% or more of reflection factor in the wavelength of 4000A thru/or a 7000A field.

[0023] On the other hand, with having mentioned above, similarly, the reflection factor of SiN500 is crossed to a wavelength field (4000A thru/or 7000A), and has 10% or less. If it is made from this the structure which carried out sequential formation of TiN with a thickness of 800A and the SiN with a thickness of 500A on aluminum, it turns out that 10% or less of reflection factor is obtained in the wavelength of 4000A thru/or a 7000A field.

[0024] Furthermore, TiN to which thickness was changed, and SiN whose thickness is 500A are explained using drawing 4 about the relation between the reflection factor at the time of carrying out sequential formation, and the wavelength of a light field on aluminum. In drawing 4 , the thickness of * of TiN is 400A (henceforth TiN400), the thickness of ** of TiN is 800A (henceforth TiN800), and the thickness of ** of TiN is 1200A (henceforth TiN1200). Although TiN400 shows 10% or less of reflection factor the wavelength of 4000A thru/or in 5900A, it shows 10% or more of reflection factor in 5900A thru/or 7000A. On the other hand, the reflection factor of TiN800 and TiN1200 is crossed to a wavelength field (4000A thru/or 7000A), and shows 10% or less of reflection factor. If it is made from this the structure which carried out sequential formation of the with 800A in thickness, and a thickness [500A in 1200A TiN and thickness] SiN on aluminum, it turns out that 10% or less of reflection factor is obtained in the wavelength of 4000A thru/or a 7000A field.

[0025] As mentioned above, if aluminum is used for light-shielding film 13a and the antireflection film 14 of the structure which carried out sequential formation of the SiN of 800A in thickness, 1200A TiN, and thickness 500 on-SUTOROMU is used on this light-shielding film 13, it can cross throughout the wavelength of 4000A thru/or a 7000A light field, and the reflection factor of read-out light can be stopped to 10% or less. For this reason, it can prevent invading into the pixel which the reflected light of read-out light adjoins, and contrast can be raised. Consequently, the display image which has good contrast can be obtained in the liquid crystal display of the veneer method which uses only one liquid crystal panel.

[0026] Moreover, by three sheets, in the liquid crystal display of 3 plate methods using a liquid crystal panel, since it can cross throughout the wavelength of 4000A thru/or a 7000A light field and the reflection factor of read-out light can be stopped to 10% or less, the liquid crystal panel of three sheets corresponding to three-primary-colors light can be communalized, and productivity improves. Furthermore, it can prevent that the read-out light which carries out incidence from pixel inter-electrode spare time 15a reaches MOS transistor 2, and degrades the transistor engine performance.

[0027]

[Effect of the Invention] According to the reflective mold liquid crystal display of this invention, since it consists of a nitride by which sequential formation was carried out on said light-shielding film, and a dielectric film with which said insulating layer and refractive index differ from each other, an antireflection film can prevent the light which invades from pixel inter-electrode reflecting, reaching a transistor, and degrading the transistor engine performance. Since aluminum is used for a light-shielding film and SiN of 800A in thickness, 1200A TiN, and thickness 500 on-SUTOROMU is used for the antireflection film of the structure which carried out sequential formation on this light-shielding film, it can cross throughout the wavelength of 4000A thru/or a 7000A light field, and the reflection factor of read-out light can be stopped to 10% or less. For this reason, it can prevent invading into the pixel which the reflected light of read-out light adjoins, and contrast can be raised. Consequently, the display image which has good contrast can be obtained by the veneer method which uses only one liquid crystal panel. Moreover, by three sheets, by 3 plate methods using a liquid crystal panel, since it can cross throughout the wavelength of 4000A thru/or a 7000A light field and the reflection factor of read-out light can be stopped to 10% or less, the pixel of three sheets corresponding to three-primary-colors light can be communalized, and productivity improves.

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing 1 pixel of the liquid crystal panel of the reflective mold liquid crystal display of this invention.

[Drawing 2] It is drawing showing the reflection factor, wavelength, and relation at the time of making the thickness of the silicon nitride by which sequential formation was carried out, and titanium nitride fix on aluminum.
[Drawing 3] It is drawing showing the relation between the reflection factor at the time of fixing the thickness of titanium nitride on aluminum among the silicon nitride and titanium nitrides by which sequential formation was carried out, and changing the thickness of silicon nitride, and wavelength.
[Drawing 4] It is drawing showing the relation between the reflection factor at the time of fixing the thickness of silicon nitride on aluminum among the silicon nitride and titanium nitrides by which sequential formation was carried out, and changing the thickness of titanium nitride, and wavelength.
[Drawing 5] It is the sectional view showing 1 pixel of the liquid crystal panel of the conventional reflective mold liquid crystal display.
[Drawing 6] It is the top view showing signs that the conventional reflective mold liquid crystal display was seen from the top face.
[Description of Notations]
1 — A silicon substrate (substrate), 2 — A MOS transistor, 3 — Retention volume, 4 [— Gate,] — An interlayer insulation film (insulating layer), 5 — A liquid crystal cell, 6 — The source, 7 8 [— Maintenance electrode,] — A drain, 9 — A separation oxide film, 10 — A high concentration layer, 11 12 [— Titanium nitride (nitride) 14b / — Silicon nitride (dielectric film), 15 / — A pixel electrode, 15a / — Pixel inter-electrode spare time, 16 / — A liquid crystal layer, 17 / — Glass substrate] — A wiring layer, 13a, 13b — A light-shielding film, 14 — The antireflection film, 14a

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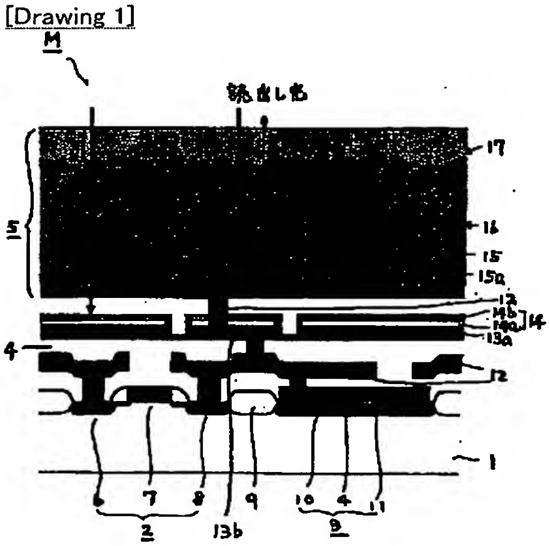
[Translation done.]

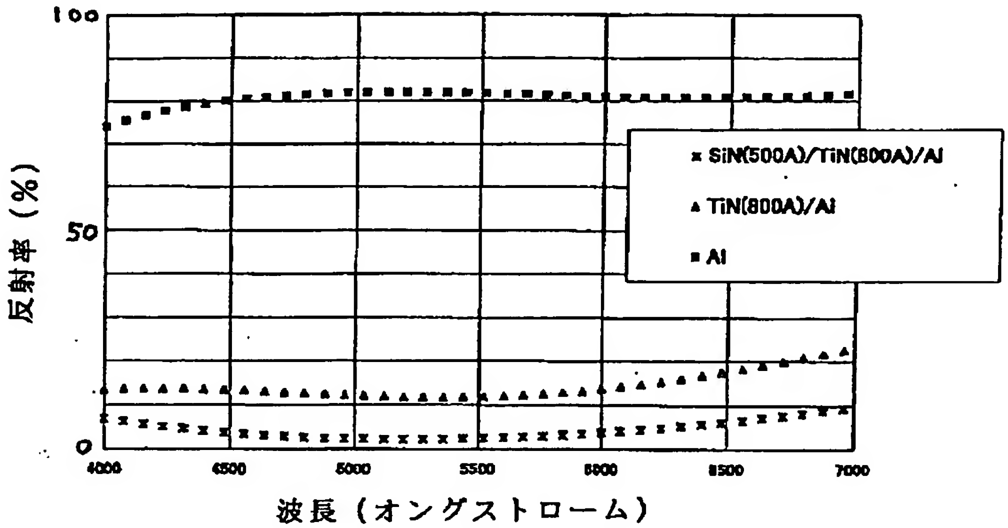
* NOTICES *

DRAWINGS

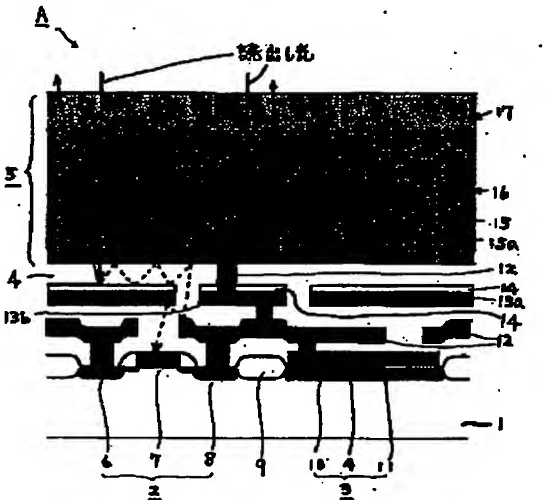
[Drawing 1]



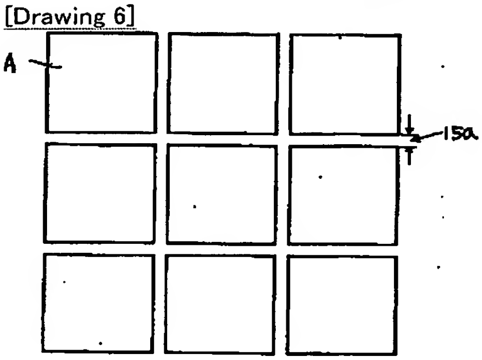
[Drawing 2]



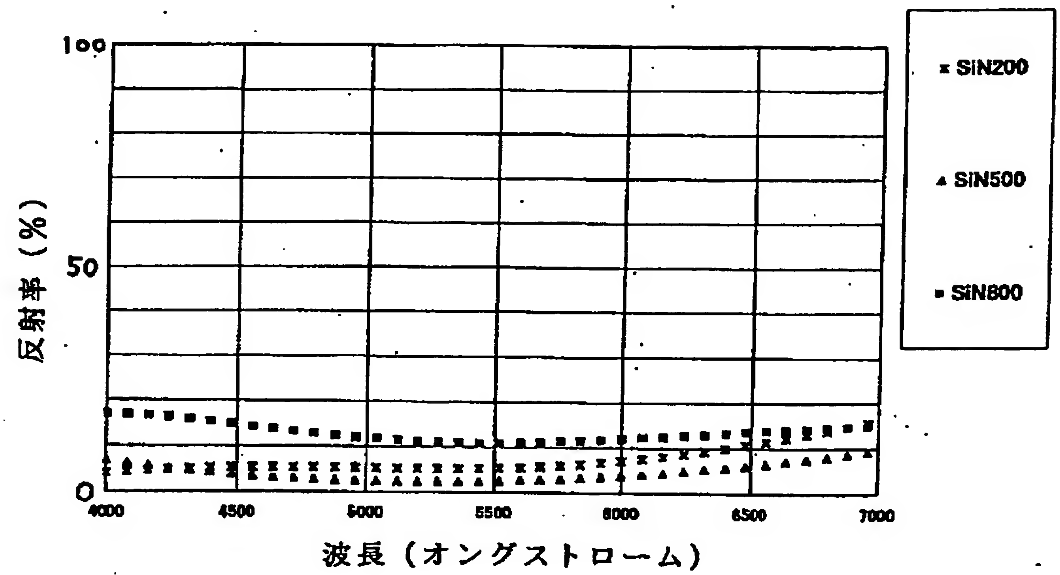
[Drawing 5]



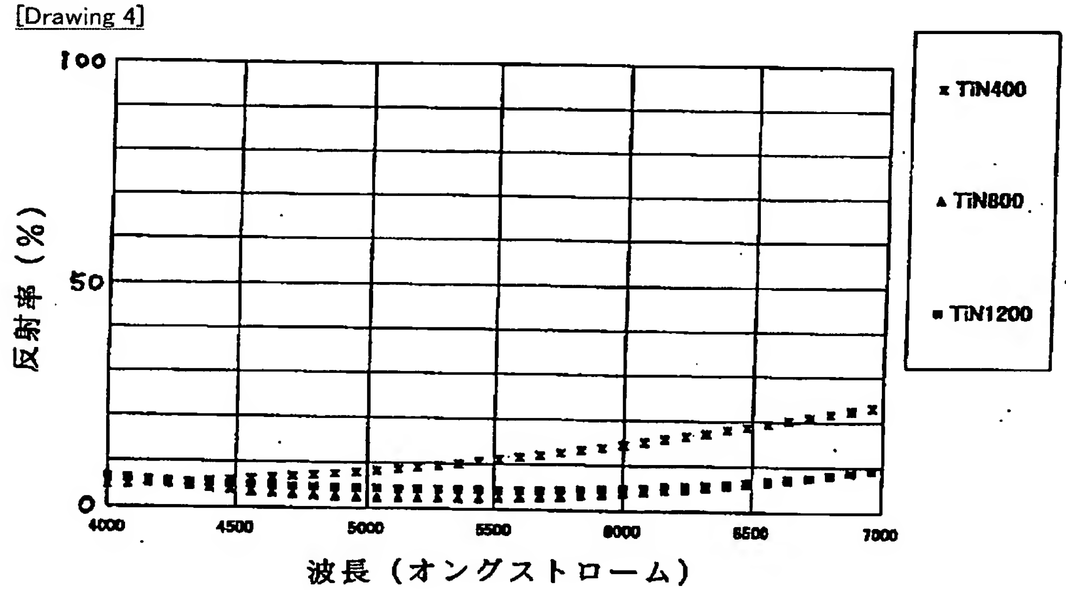
[Drawing 6]



[Drawing 3]



[Drawing 4]



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